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**Investigation of Air Pollution in Port Sudan City Due to
Nitrogen Oxides (NO_x) Exhaust Emissions from Stationary Diesel Generators**

A thesis submitted in partial fulfillment of the requirement for the degree of
M.Sc. in Electrical Power Systems

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Dedication

To my beloved father, late Ustaz Arop Yor Ayik, who made the world a better place for us, by investing all he had on our education.

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Abstract

The main objective of this study is to investigate air pollution in Port Sudan city due to nitrogen oxides (NO_x) exhaust emissions from stationary diesel generator units located in certain areas of Port Sudan city (areas east city, Port Sudan harbor, eastern parts of city center and the National Electricity corporation station-Station A).

This objective is achieved by measuring nitrogen oxides concentration in exhaust emissions from diesel generator units and estimating nitrogen oxides emission rates. Nitrogen oxides concentrations are measured using a single gas exhaust gas analyzer (the Kane Auto 1- NO_x gas analyzer) and measurements are taken directly from the exhaust pipes of the diesel engines driving the generator. Nitrogen oxides emission rates are calculated in g/kWh using United States Environmental Protection Agency (U.S EPA) test method no.19 which is used for determination of sulphur dioxide removal efficiency and particulate matter, sulphur dioxide, and nitrogen oxides emission rates.

Calculated nitrogen oxides emission rates are then compared with U.S EPA emission standards for stationary compression ignition engines. Many diesel generators are found exceeding standards and Chinese type single cylinder type of generators together with diesel generators located in station (A) of the National Electricity Corporation are found to have the highest NO_x emissions.

Future works on pollution problems encountered in Port Sudan are recommended.

المستخلص

الهدف الاساسي لهذه الدراسة هو البحث في تلوث الهواء في مدينة بورتسودان نتيجة أكاسيد النيتروجين المنبعثة من عادم وحدات التوليد الكهربائية الثابتة التي تعمل بوقود الديزل في مناطق معينة بمدينة بورتسودان (المنطقة شرق المدينة، منطقة ميناء بورتسودان، المنطقة الشرقية لوسط المدينة ومحطة الهيئة القومية للكهرباء- محطة التوليد(أ))

تم تحقيق هذا الهدف بأخذ قياسات (قراءات) لتركيز أكاسيد النيتروجين المنبعثة من عادم وحدات المولدات التي تعمل بوقود الديزل ومن ثم تحديد معدل أكاسيد النيتروجين المنبعثة منها. تم قياس تركيز أكاسيد النيتروجين باستخدام جهاز محلل غازات العادم أحادية الغاز موديل (Kane auto 1-Nox gas analyzer). حيث تم أخذ القراءات مباشرة من فوهة ماسورة العادم لماكينات الديزل المحركة للمولدات.

تحتسب معدل انبعاث أكاسيد النيتروجين بوحدة تعرف بإسم جرام/ كيلواط- ساعة باستخدام معيار وكالة حماية البيئة التابعة للولايات المتحدة الأمريكية المعروفة بطريقة الاختبار رقم 19 (Test Method No.19) والتي تستخدم لتحديد كفاءة إزالة ثاني أكسيد الكبريت ومعدل انبعاث المواد العالقة و أكاسيد النيتروجين. تمت مقارنة معدل انبعاث أكاسيد النيتروجين المحتسبة من بيانات القياسات مع تلك الموجودة في معايير وكالة حماية البيئة التابعة للولايات المتحدة الأمريكية (US EPA) والخاصة بماكينات الديزل الثابتة. ولقد وجد ان معظم المولدات التي تم إختبارها تحتوي علي معدل عال للتلوث من أكاسيد النيتروجين خاصة المولدات صينية الصنع أحادي السلندر ومولدات المحطة (أ) التابعة للهيئة القومية للكهرباء.

في الختام أوصي البحث بأجراء بحوث مستقبلية حول مشاكل تلوث الهواء في مدينة بورتسودان

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